Improvement of Feeder Technologies for Energy Savings in Cast Iron Foundries

Vedel-Smith, Nikolaj Kjelgaard

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Improvement of Feeder Technologies for Energy Savings in Cast Iron Foundries

Nikolaj Kjelgaard Vedel-Smith,
M.Sc. , Ph.D.-candidate

Introduction

The project aims at reducing the consumption of electrical energy in the heaviest part of energy consumption in the Danish foundries. This will take place by developing feeder technologies for use in Danish and foreign iron foundries. In Europe the primary savings alone are expected to be 2.3 TWh. This corresponds to a reduced CO_2 emission of 1.3 Mt annually.

WHY

Environmental Impact

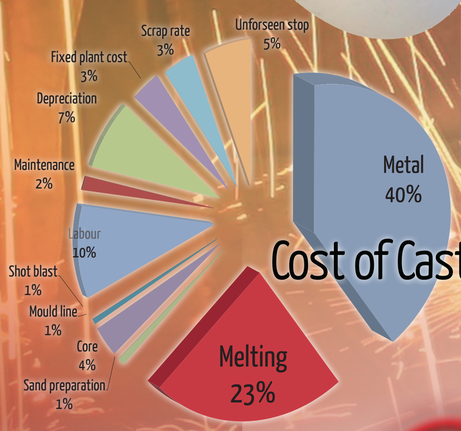
Castings are used everywhere. It has been in use for thousands of years and is today one of the central production methods without which our modern society would not be functioning. While casting has a long history, especially compared to newer technologies as CNC-milling and 3D-printing, casting is still a highly developed production process. Moreover, casting remains superior with respect to life cycle environmental impact, as it was show by a comprehensive LCA of the Danish manufacturing industry [1, 2].

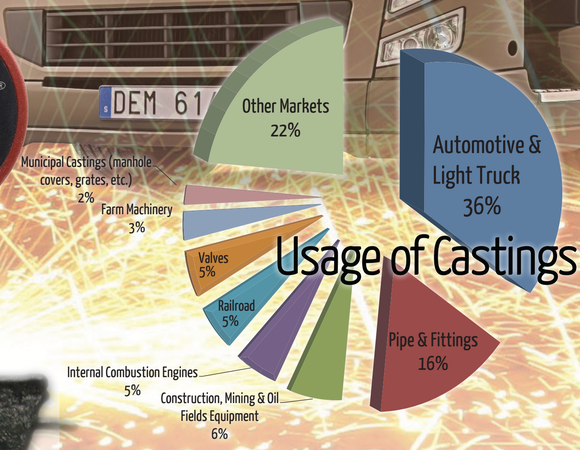
Cast Products

Cast products are an integral part of our daily lives. Castings vary from the smallest pieces of 100 g and up to colossal structures weighing 300 t. Castings are found in cars, trucks, ships, wind turbines, food processors, projectors, generators, children's toys, traffic lights, cityscape equipment, power tools, pumps, mining machinery, and even bridges.

Effect

With an annual cast iron production of 13.5 Mt of finished goods in Europe—75,000 tonnes in Denmark alone. With a casting yield of 50 %, 32 TWh are used for melting iron. The process improvements suggested in this project can potentially reduce this energy consumption by as much as 2.3 TWh annually. This corresponds to ⅓ of the total annual energy use for the entire city of Copenhagen, including electricity, heating, oil and city gas (but excluding transport) [3]. And this is without including any secondary effects of the process improvements.

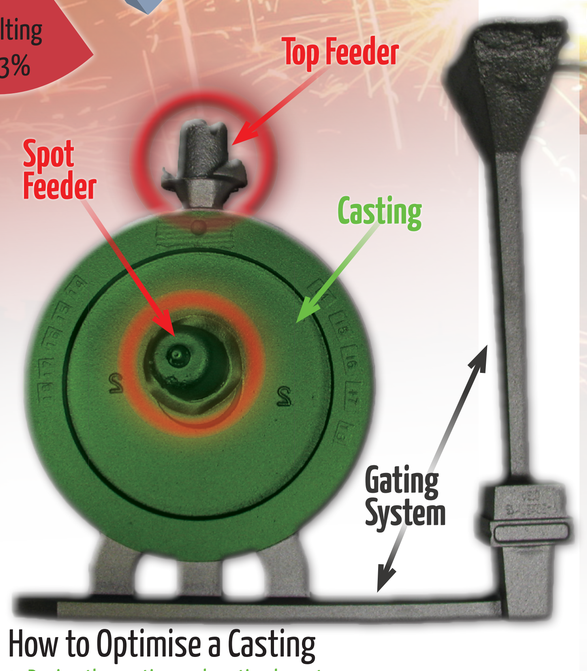




WHERE

Better feeding reduces...

- energy required for melting
- use of sand,
- energy for holding the melt,
- need for cooling,
- general resource consumption, and
- energy for heat treatment



How to Optimise a Casting

1. Design the casting and casting layout
2. Optimise the feeding of the casting **(FOCUS AREA OF THIS PROJECT)**
3. Adapt the gating system to support the feeding of the casting

Correct feeding improves...

- ventilation cost in the foundry,
- handling of the goods after casting,
- transport of the goods, and
- the operation of the finished product!

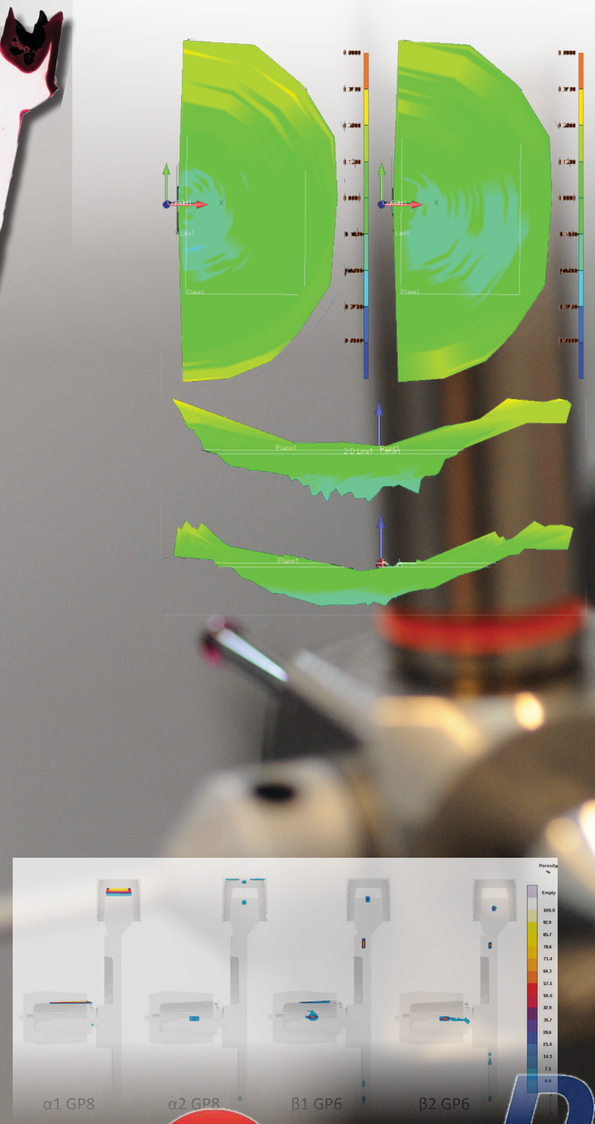
WHERE

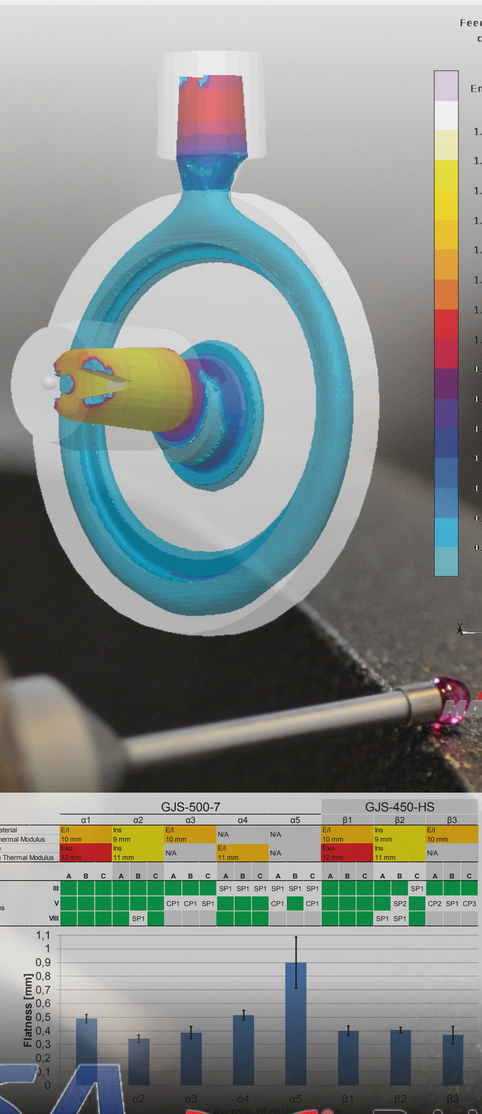
The focus of this project is better production of cast iron products; more specifically optimisation of feeding mechanisms. While the project focus is narrow, the effects are holistic. Improving feeder technologies influences many other parts of the production process, thus reducing resource consumption for sand, melting, holding, heat treatment, etc. The overall poured weight is often reduced by the optimised design of the casting itself and the gating system. Finally, energy savings can be found in ventilation in the foundry, handling and transport of the goods, and reduced energy use for the castings in operation due to reduced weight [4].

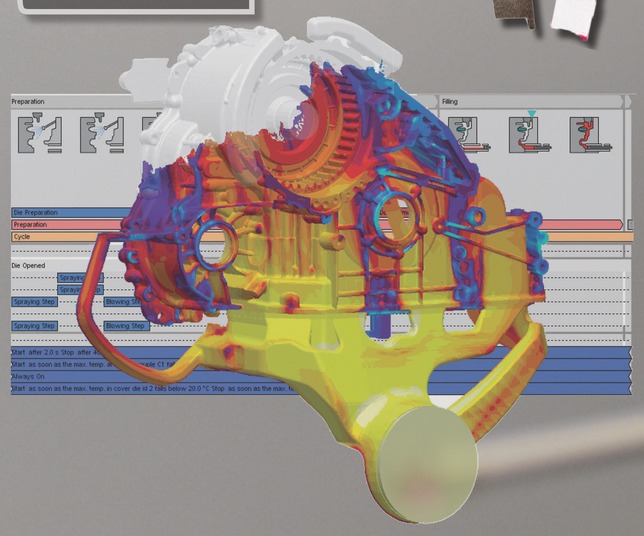
HOW

Producing the best possible castings is not an easy task. The casting process and final product comprises many contradicting objectives, which must all be taken into account when designing and producing castings. The process of casting is complex and everything is entangled: the alloy, the casting temperature, the casting design, how the melt hits the cup, the moisture in the air, etc. The best casting process is the stable and reliable process, which produces sound casting every time. Often, well designed and optimised processes which yield stable results are also those with a low energy and resource consumption. The key to this is understanding.

- **Optimised gating systems**
  - » *Enable lower casting temperature*
- **Simulation**
  - » *Enable better understanding of process*
  - » *Choosing the best solutions*
- **Spot feeding**
  - » *Enables optimised casting design*
- **Distortion predictions**
  - » *Improved optimisation of cast design*
- **Alloy properties**
  - » *Solidification characteristics*
  - » *Feeding paths*
- **Improved feeding tools**
  - » *Like active feeders, and*
  - » *Thermal gradient control*







About the Project

This project is focused on the development of feeder technologies for cast iron foundries. By improving feeding mechanisms products can be made cheaper, using less energy and resources, and often also with better performance. Using these technologies increase competitiveness for the foundries by either increasing their profit margin or by offering cheaper solutions to their customers.

Working together to achieve this goal is a consortium of five partners, each a leading institution within their respective field. The consortium contains all five parts of the foundry business: Primary Research (DTU MEK), Machinery (DISA Industries A/S), Simulation (MAGMA GmbH), Foundry Consumables (FOSECO Ltd.), and Foundry Practise itself (Vald.Birn A/S).

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